

What is claimed is:

Sub
A2

1. A method for enhanced imaging of a target medium comprising:
directing energy into a target medium from at least one source during a period of time, the target medium having dynamic properties during the period of time;
measuring the density of the energy emerging from the target medium during the period of time using at least one detector, the density of the energy emerging from the target medium being a function of the dynamic properties of the target medium; and
generating a map of the dynamic properties of the target medium based on the measured density of energy emerging from the target medium.

2. The method of claim 1, further comprising:
generating a time series of images of the properties of a target medium based on the measured energy emerging from the target medium, wherein each image represents the cross-sectional properties of the target medium at a time interval during the period of time.

3. The method of claim 2, wherein generating the map of the dynamic properties of the target medium comprises processing the time series of images using time series analysis methods.

4. The method of claim 1, wherein generating the map of the dynamic properties of the target medium comprises processing the measured energy at each detector using time series analysis methods.

5. The method of claim 1, wherein the image of the dynamic properties is generated using time series analysis methods.
6. The method of claim 5, wherein the time series analysis methods comprise linear time series methods.
7. The method of claim 6, wherein the linear time series analysis methods are at least one of frequency analysis, time correlation analysis, time frequency analysis and principle component analysis.
8. The method of claim 5, wherein the time series analysis methods comprise nonlinear time series analysis methods.
9. The method of claim 1, wherein measuring the energy comprises a plurality of measurements collected at a sampling rate not less than twice the reciprocal of the highest frequency of a dynamic property to be imaged.
10. The method of claim 1, further comprising applying a provocation to the target medium.
11. The method of claim 1, wherein the target medium is human tissue having a vascular tree and the provocation has a dynamic effects on the vascular tree.
12. The method of claim 11, wherein the provocation is an autonomic stimulus.
13. The method of claim 11, wherein the provocation is a local stimulus.
14. The method of claim 1, wherein the energy is optical energy having a wavelength in the near infrared region of the electromagnetic spectrum.

16. The method of claim 14, wherein the target medium is human tissue having a vascular tree containing blood, the vascular tree comprising veins, arteries and micro vessels, the blood having time varying absorption and scattering properties to the near infrared energy as a function of blood oxygenation and blood volume.

18. The method of claim 16, wherein generating an image of the dynamic properties of the target medium further comprises using time series analysis to enhance the contrast of at least one of veins, arteries and micro vessels.

20. The method of claim 1, wherein generating an image of the dynamic properties of the target medium further comprises processing the measured energy using a modified perturbation formulation of the radiation transport equation, wherein the modified perturbation formulation uses relative energy measurements.

21. The method of claim 20, wherein the relative energy measurements are the relative differences between a measure at an instant in time and a time average mean of measures during the period of time.

7-00000000000000000000000000000000

22. A system for enhanced imaging of a target medium comprising:

a source for directing energy into a target medium from at least one source during a period of time, the target medium having dynamic properties during the period of time;

a detector for measuring the density of the energy emerging from the target medium during the period of time using at least one detector, the density of the energy emerging from the target medium being a function of the dynamic properties of the target medium;

a data acquisition means for receiving the measured energy densities during the period of time; and

a computer connected to the data acquisition means, the computer having code for generating a map of the dynamic properties of the target medium based on the measured density of energy emerging from the target medium.

23. The system of claim 22, wherein the computer further includes code for generating a time series of images of the properties of a target medium based on the measured energy emerging from the target medium, wherein each image represents the cross-sectional properties of the target medium at a time interval during the period of time.

24. The system of claim 23, wherein the computer further includes code for processing the time series of images using time series analysis methods to generate the map of the dynamic properties.

25. The system of claim 24, wherein the computer further includes code for processing the measured energy at each detector using time series analysis methods to generate the map of the dynamic properties of the medium.